

NEWS REPORT

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NEWS REPORT

National Academy of Sciences National Research Council

VOLUME XI

January-February 1961

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Environmental Effects on Materials and Equipment

CARL J. WESSEL, *Director*
Prevention of Deterioration Center

WORDS, like missiles, often lack precision. The word "environment" is meant to convey a rather vague, almost limitless complex of conditions which in their sphere of influence may affect, even critically control, intellectual concepts or material objects. Yet, the word is burdened with a variety of definitions and connotations that oftentimes do a disservice to fields of endeavor labeled "environment."

Dictionaries say that to "environ" means "to form a ring around, to surround, encompass or encircle; hence to hem in, involve, envelop." The lexicographers proceed saying, "that which environs; the surrounding conditions, influences, or forces, influence or modify." Exemplary of the broad application or references to environments which are climatic, biological, political, sociological, educational, cultural, artistic, and, by extension, scores of others. Scholars in almost any field may use the word with impunity.

In this brief treatise, reference points to the "physical" environment. And "physical" is taken in the sense of pertaining to, or in accordance with, the laws of nature relating to material things as opposed to things

mental, moral, spiritual, or imaginary. The physical sciences, in this sense, and as set off from, say, the social sciences, would include the disciplines of physics, chemistry, biology, engineering, as well as their many subdivisions, and would utilize the principles and tools provided by mathematics.

Let us now focus our attention on materials and equipment. It is evident to practically the entire scientific community that great emphasis is being placed on obtaining greater knowledge of materials. Today's scientific and technological demands are more severe than ever before encountered. Never in history has man been able to implement his desire to make vehicles travel at speeds in the order of thousands of miles per hour, at temperatures expressed in thousands of degrees, under conditions of near vacuum, through areas of high radiation, or even to conceive of missions bridging distances of hundreds of thousands or even millions of miles.

Since the time when men first started using materials, there has been a relationship between these materials and the environment into which they were placed. It is easy to imagine that the first materials

used, such as animal skins and wood, gradually became useless at least partially because of the effects of rain, wind, heat, sunlight, ozone and other components of the natural climatic environment. As science and technology assumed more importance and made available more and more materials of greater and greater diversity, the environment-materials relationship gained more exacting proportions.

Today, the scientific and engineering community, under the pressures of modern developments, is opening every available door and searching out every nook and corner to find and develop every possible material which may have unique and hitherto undreamed of properties that will enable men to explore frontiers never before approached. The environment-materials complex today is a critical factor of major status.

In "The Challenge of the Materials Age" (*Materials in Design Engineering*, September 1960, pp. 123-174), statements such as the following illustrate the present situation:

The Materials Age is here and will be with us for a long time to come. * * * It is an age in which most advanced mechanisms are critically dependent on materials. * * * The Materials Age is an age made by man. It is an age that calls for men capable of grasping and using the new science of materials for men farseeing enough to break down the conventional barriers of the various engineering disciplines.

If one recognizes and accepts the claim that our's is the materials age, one also must accept the corollary environment-materials relationship. The recognition of this relationship is expressed emphatically in the "Summary of Recommendations for Research and Development in Materials," prepared by Office of Fuels, Materials and Ordnance, Office of the Director of Defense Research and Engineering, Department of Defense, 1 July 1960, and available from Office of Technical Services (PB-161865). Appropriate quotations include the following, taken out of context but reflecting the general complexion of the report:

Materials and methods for the protection of less stable materials must be developed. These methods may consist of preservative chemicals, corrosion inhibitors, electro-depositions, inert coatings, flame spray techniques, and methods for protection other than conventional shielding.

Numerous recommendations have stressed the need for acquiring more and better data on actual environments—both natural and induced—as a necessary first step in the development of systematic data on the performance of materials exposed to the varieties and complexities of environmental stresses. While emphasis has been placed on such extreme environmental conditions as those of high-speed flight, reentry, and space, it is believed that methods for correlating natural environments with simulated laboratory environments should be critically examined and perfected. Data on more or less conventional terrestrial environments also stand in need of much refinement.

Elevated-temperature-test procedure standardization needs urgent attention. * * *

One relatively unexplored area is the determination of the effects of hyper-environments, both singly and in combination, on materials. For the future of manned vehicles, such information would be significant as additional design criteria for materials selection. The nonexistence of suitable test chambers and, in some cases, the methods of simulation, have limited the required effort in this field.

The development of materials to meet very severe requirements (nose cones, rocket nozzles, etc.) is hampered by the unavailability of suitable simulated-service-test equipment for use by producers of materials.

When one has recognized and accepted the environment-materials relationship in this materials age and moves on to an analysis of this relationship, one arrives at an understanding of the fact that in many cases components of the environment cause materials (or the equipments made from materials) to depart from, or completely lose, the properties for which they have been chosen or designed. Thus, for our purpose it may be said that "environment" denotes that complex of forces or manifestations of energy on earth, in or under the sea, in the atmosphere, or in space—encountered during transportation, storage, or operation—which tend to cause material entities to deteriorate, i.e., undergo a loss in value, or to decrease the ability of a product to fulfill the purpose for which it was intended.

With reference to deterioration of materials and structures, the "Summary of Recommendations," cited above, emphasizes:

An orderly approach to the problem of preventing premature deterioration of military hardware appears to require:

(1) The development of a taxonomy of deterioration based on substances, interactions, environmental stresses, and processes of deterioration.

(2) The development of a taxonomy of environments into natural and induced; ground, air, and space; land and water; and geographical.

(3) The development of fundamental scientific data to assemble into the matrices supplied by (1) and (2) above.

(4) Development of data from inspection reports on the response of military equipment to conditions of storage and operation in order to secure information on the operational effectiveness of equipment, the dollar costs of deterioration, and the effect of deterioration on the logistic process.

(5) The employment of failure data developed under (4) to provide program guidance under item (3) above.

(6) The prompt and systematic assembly of data developed under (3) above into comprehensive design guidance based on the taxonomies established under (1) and (2).

One of the long standing branches of endeavor of the Academy-Research Council, the Prevention of Deterioration Center, since its inception has been devoted to the environment-materials relationship. The background which led to organizing the Prevention of Deterioration Center is traced to the year 1945, when the Center was established as an outgrowth of the wartime OSRD-NDRC Committee on Tropical Deterioration. The support of the Center has been solely by funds from the Army, Navy, and Air Force, through an office of Naval Research contract with the National Academy of Sciences. The Center's responsibilities, until 1960, were in the field of "natural" environment materiel deterioration and its prevention and the Center provided the Armed Services with advisory, consulting, and general information services comprising a variety of related functions in the environment deterioration field. Emphasis in the "natural" environmental realm is on moderate heat, sunlight, wind, sand, dust, moisture in all forms, oxygen, ozone, salts, acids, alkalies, mildew and rot organisms, bacteria, insects, and marine organisms. It remains the responsibility of the Prevention of Deterioration Center to continue the services it has been providing in the field relating materials and equipment to their "natural" environment.

In 1957, the Center was approached by the Air Force which signified the need for a similar service in the "induced", "hyper", or "space-associated" environments. A sur-

vey by the Center of the need and possible type of such service, conducted in cooperation with the Air Force, Army, and Navy led to the enlargement of the Center's function in June 1960. In entering the newer field of the "induced" environments, the Center expects to provide eventually many of the same types of services it currently is offering in the "natural" environments. In the "induced" realm, the emphasis is on physical and engineering aspects of mechanical shock, vibration, excessive heat, vacuum, gravity, magnetism, electromagnetic radiation, dissociated and ionized gases, plasma, meteoritic dust, aurorae, and coronae.

The effects of the "induced" environments are as truly deteriorative of materials and equipment properties as are those of the "natural" factors. It is apparent that the choice of words to classify the newly important environments—induced, hyper, operational or space-associated—is somewhat confusing and inadequate. It is hoped that in time a more satisfactory designation will be found. Many of the newly recognized environmental factors are, for example, quite "natural." For the purpose of this discussion, however, the terms *natural* and *induced* are being used as a matter of convenience.

As its initial contribution to the field of the induced environments, and to assist design engineers, materials scientists, specification writers and evaluators, test services, research directors and others charged with responsibility for guaranteeing the reliability, operability, durability or service life of all military materiel in all environmental conditions of use, the Center is commencing publication in January, 1961, of a new, unclassified monthly abstracts journal, *Environmental Effects on Materials and Equipment*. Each issue, scheduled to appear on the fifteenth of the month, will contain at least 40 substantive abstracts plus 40 or more "extracts" (telegraphic or key word abstracts) of current articles drawn from the world's scientific literature concerned with the effects of "induced" environments. Although each issue will contain its own index, cumulative author and subject indexes will be provided at the completion of each annual volume.

This new series complements the continuing publication of the Center, *Prevention of Deterioration Abstracts* (now in Volume 18), a service covering effects of the "natural" climatic environmental factors. It is a future goal to combine both publications as two sections under the new title. The two publications, taken together, will reflect the literature covering the majority of environments which adversely affect materials and equipment.

In general, the scope of the new series is limited to the abstracting of articles on the effects of factors, or combinations of factors, of induced environments on materiel plus articles on the factors themselves, as well as on testing techniques. Areas currently being covered by other information agencies will usually be excluded. For example, no effort will be made to report information on effects of artificially produced nuclear radiation on materials. No articles dealing with environmental effects

on foods, drugs, or man will be abstracted, unless a clear relation of effects on materials or equipment is evident.

The Center is aware of the formative and, possibly, unsatisfactory terminology in the environmental field today. The terminological vagueness manifest in the literature renders it very difficult to arrive at definitions of terms fully acceptable to all persons and groups concerned. Until such time when standard, formal definitions are generally adopted, the Center will utilize definitions stated or connoted by the literature. The listing of "key words" and other index terms suffers in proportion to the variable terminology extant. On occasion, it will be necessary to resort to arbitrary selection of key words to avoid excessive synonymy. Decisions such as these, it is believed, may be a service to the field by aiding in the search for a practical nomenclature.

Four Decades of the Highway Research Board

FRED BURGGRAF, *Director*
Highway Research Board

DURING the week of January 9, 1961, the Highway Research Board of the National Academy of Sciences-National Research Council conducted its 40th annual meeting. Two general sessions of the Board were in observance of this 40th birthday. The first of these was on the theme of what transportation may become in the future, envisioning a transportation system with many a new look resulting from progress in science and technology. The speakers sketched some of the impacts of potential new modes of transportation on man's pattern of living and of making a living. The second general session in observances of attaining the age of 40 was

a dinner meeting at which the Director of Highway Research Board reviewed the establishment of the Board and traced, in summaries by decades, the growth of the Board. This growth, incidentally in size, was more significant in prestige and influence as witnessed in the Board's wider contacts with and support from industry, universities, and all levels of government, Federal, state, county, and municipal. An outstanding development was the Board's increasing concern over the years with the interaction of highway transport of goods and people with other modes of transport and with the social, economic, and political development of the country.

The First Decade, 1920-30

The first decade of the Board's life began in 1920 when, on October 26, Chairman C. A. Adams of the Division of Engineering and Industrial Research of the National Research Council addressed a letter to the governing boards of certain national organizations, federal and state highway departments and educational institutions, stating the need for highway research, outlining the projected committee organization, and inviting representatives to a conference for the purpose of completing the organization. At that meeting, held on November 11, 1920, an Advisory Board on Highway Research was formally organized and by-laws adopted. The first annual meeting of the Board was held in the Engineering Societies Building, New York City, on January 16, 1922.

During the 1920's, Professor William K. Hatt, on leave from Purdue University where he was professor of civil engineering, was the Director from 1922 to 1923. C. M. Upham served from 1924 to 1928, and upon his resignation in 1928, Roy W. Crum became Director.

In average figures, attendance at the annual meetings during this first 10-year period was 225 with some 20 papers or reports presented during the 2-day sessions.

These reports were on wind resistance to vehicles, tire wear, cost of vehicle operation, the question of not being able to freeze water when you want to freeze it in certain soils, and the ability to freeze it in others, the impact tests on concrete, traffic analysis, and grading of top soil mixtures for local roads. There were also reports of the tests at the Bureau of Public Roads, Arlington Experimental Farm, of the Bates Road Test in Illinois, and the Pittsburgh tests in California. Two special reports were published, entitled "Economic Value of Reinforced Concrete" and "Low Cost Improved Roads," both of which were financed by industry.

Some of these earlier papers had interesting titles in light of later developments such as: 1) The Services of Psychology to Problems of Traffic Control, 2) Application of Aerial Mapping to Highway Con-

struction, and 3) The Demonstration and Dramatization of Research. The latter was a real public relations contribution. These topics are sometimes thought of as having been recognized only in very recent years.

The News Letter as a medium to acquaint public, academic, and industrial representatives of developing research matters was inaugurated during the late 1920's.

Active representation was established through contact men with the state highway departments and with over 100 universities and colleges. That arrangement, in an expanded way, is still in existence today.

The name of the Board was changed from the Advisory Board on Highway Research to the Highway Research Board. The Executive Committee membership was increased from six to eleven.

The Second Decade, 1930-40

Some of the noteworthy innovations during this period were: 1) Creation of a Research Information Service in 1930; 2) Initiation of the synopsis procedure for all papers in Proceedings in 1931 (This is still being used); 3) initiation of the Highway Research Abstracts in May 1931 (There were about two issues a year until 1934 and since then to the present time the Abstracts have been issued monthly); 4) joint sponsorship of the Bartlett Award with the American Association of State Highway Officials (AASHO) and the American Road Builders Association; 5) establishment of active representation through contact men with 53 different cities in 27 states in 1931; 6) establishment of first joint project with AASHO on a study of the laws, funds, organization, and technical practices relating to roadside development; 7) initiation of a general policy in 1934 of charging a fee for future issues of Proceedings which had been free up to this time; 8) reorganization of the Board's work into Departments and Committees; 9) creation of a new Department of Soils in 1935; and 10) establishment of a joint arrangement with AASHO for the purpose of conducting and maintaining a highway research census in 1936.

The Third Decade, 1940-50

In the 1940's, the average attendance at the annual meetings rose to 640 and the average number of papers and reports presented was 82. During the early part of this decade, to avoid the national emergency congestion in Washington, the Board abandoned a long-established custom by leaving Washington and holding its next four assembled annual meetings outside of the city.

Here, briefly, are some of the highlights of the decade: 1) Establishment of the Highway Research Board Award in 1940 and the Highway Research Board Distinguished Service Award in 1948; 2) inauguration of procedure whereby individuals or companies may affiliate with the Board on a non-voting basis in 1940; 3) establishment of a series of lecture courses on highway economics jointly with universities and colleges (for example, Iowa State University, Texas Agricultural and Mechanical College, and Utah University); 4) initiation of a series of wartime bulletins on timely subjects, the object of which was to disseminate in usable form the best available information on those phases of highway technology in which common practice had not become established, or in which practice had to be modified during the war; 5) establishment of a joint committee with AASHO to study maintenance personnel in 1946; 6) initiation of a joint research project with the Bureau of Public Roads and the Asphalt Institute on a flexible pavement track; 7) gasoline consumption and travel-time study in Pennsylvania by the Board's Committee on Economics of Motor Vehicle Size and Weight; 8) studies of actual traffic situations with special instruments by the Committee on Vehicle Characteristics; and 9) inauguration of the Research Correlation Service in 1945.

The establishment of this service was the most significant single event in the life of the Board so far as carrying out more effectively the purposes laid down by the founders. This accounts, in a large measure, for the accelerated progress during the past 15 years.

This service is financed on a yearly subscription basis by the state highway de-

partments and the Bureau of Public Roads and accounts for about 75 percent of the Board's operating budget. The Board agrees in these contracts to "collect the available information concerning past, current and proposed research work relating to highways and highway transportation, of the Federal Government, State highway departments, colleges and universities and research agencies, study and correlate the information by means of individual and group conferences and committee activities; prepare reports and make recommendations based thereon; and disseminate such information, reports and recommendations to the subscribers to the Service and to other highway research agencies."

The Board has five professional engineers, each of whom specializes in one or more of the branches of highway technology represented by the six departments under which the technical committees operate. A considerable part of these engineers' time is spent in making periodic visits to State highway departments, colleges, universities, and other agencies engaged in highway research. These engineers also provide technical assistance to their respective departments and committees.

The Fourth Decade, 1950-60

In the 1950's there was a phenomenal growth in the Board's activities. Not only did the average attendance at the annual meetings rise to 1610 and the average number of papers and reports presented to 186, but there was also an upsurge of special research projects. Some of these were: 1) Road Test One-MD; 2) the WASHO Road Test; 3) the AASHO Road Test (the total cost of these three projects alone was about 28.5 million dollars; 4) Non-rigid pavement design; 5) effect of wind stresses on bridges; 6) intergovernmental relations in highway affairs; 7) calcium chloride stabilization; 8) relationship of parking to business; 9) laws study; 10) urban research; 11) study of friction piles for highway structures; 12) research problems of mutual interest and concern to users and producers of asphaltic materials; 13) special study for department of defense on effects of military aircraft on airfield pave-

ments; and 14) arrangement of exchange of soil scientists between Russia and the United States. During this decade the Board's volume of publication increased from 2,000 pages to over 5,000 pages per year.

To keep pace with this increased activity the Executive Committee membership was increased from 11 to 21 with the new members representing disciplines which were deemed necessary.

During the latter part of this decade the Department of Economics, Finance, and Administration sponsored three special workshop conferences: 1) Economic impact of Highway Improvement; 2) Economic Analysis Relating to Planning, Location, and Design; and 3) Highway Construction Programming.

It has been said that "Research knowledge in highway engineering grows by accretion." In the unfolding 40 years of activity of the Highway Research Board no single discovery has claimed leading notice. But each year has added to the accumulated knowledge placed at the service of highway transportation through the contributions of the multitude of technical men who have carried on the activities of the departments and committees of the Board and who have made effective the Board's annual meetings. There is little doubt that these meetings over the past 40 years have also contributed greatly to the development of the men who have advanced the technology of highway transport.

SCIENCE NEWS

MOHOLE EXPERIMENTAL OPERATIONS

The first phase of test operations for possible use in Project Mohole will begin this spring as soon as the drilling barge, *Cuss I*, has been remodeled to conduct special tests of new drilling and navigation equipment, necessary to penetrate the ocean floor. The ultimate goal of Project Mohole is to drill through the earth's crust under the ocean to determine the composition and physical properties of the crust and of the underlying rock known as the mantle.

A test site for the experimental drilling has been chosen near Guadalupe Island, about 200 miles off the West Coast of Mexico, where the ocean is 12,000 feet deep. Previous offshore drilling has been confined to water depth of several hundred feet.

A contract for the test drilling has been awarded the Global Marine Exploration Co. of Los Angeles by the National Science Foundation. The \$735,750 contract calls for modification of the company's 260-foot drilling ship, *Cuss I*, and use of the ship for about a month.

Project Mohole is under the guidance of the AMSOC (American Miscellaneous Society) Committee, composed of leading earth scientists and engineers and affiliated with the Academy-Research Council, with Gordon Lill serving as Committee chairman and Willard Bascom as project director. Actual drilling of the Mohole will depend upon the outcome of the experimental drilling, subsequent engineering and design studies, and site surveys, and is not expected to begin for several years.

The site for the experimental drilling in phase one is in the vicinity of latitude 29° N., longitude 117°30' W., where sampling and sonic surveys have indicated that the first 500 feet of ocean bottom consists of unconsolidated soft sediments with hard layers below.

Drilling will be done by the standard rotary method used on land by the petroleum industry. All holes will be uncased—that is, the only connection between the ship and the sea floor will be the drill pipe itself. This means that once a bit has been withdrawn from the hole, the hole cannot

be re-entered. Therefore, all sampling and measuring operations must be conducted by lowering tools and instruments through the drill pipe on a cable, or wire line. Diamond bits will be used because both very soft and very hard rocks will be encountered.

Feasibility studies conducted by the AMSOC Committee have indicated that the unmoored ship will be able to maintain position with the use of four outboard motors mounted at the corners of the ship. The ship's position will be determined relative to a ring of buoys anchored to the bottom and held several hundred feet below the surface by taut lines.

The buoys will be equipped with sonar transponders, or "pingers", which respond to sound waves sent through the water by the ship in the middle of the circle. Electronic equipment on the ship will translate the signals received into distance and present this to the pilot so that he can maintain position in relation to the buoys. The pilot will regulate the amount and direction of thrust of the steering motors through a central control to maintain the ship's position over the hole.

Oceanographic vessels of the Scripps Institution of Oceanography, University of California, are scheduled to be at the drilling station to provide accommodations for a number of participating scientists from universities, the petroleum industry, and Federal agencies. These will include paleontologists, geophysicists, sedimentary petrologists, and microbiologists, as well as a meteorologist and a physician. The U. S. Navy has assigned a tug to assist the operation.

Many government and private organizations have contributed and are continuing to contribute generously of time, equipment, and personnel to this first testing operation. Among these contributors are: U. S. Army Corps of Engineers; U. S. Navy Bureau of Ships, Office of Naval Research, and Bureau of Yards and Docks; Christensen Diamond Products Company; Industrial Distributors, Ltd. of Johannesburg, Union of South Africa; and International Business Machines. Many other industrial firms and oil companies have also donated equipment and services.

PACIFIC SCIENCE BOARD TO STUDY ULITHI ATOLL

The Pacific Science Board sent out a three-man team in mid-January to study the effects of the November 1960 typhoon as it passed over Ulithi Atoll, one of the Caroline Islands. The group is composed of W. A. Lessa, Associate Professor of Anthropology, University of California at Los Angeles; David I. Blumenstock, climatologist with the U. S. Weather Bureau in Honolulu; and Charles G. Johnson, U. S. Geological Survey, Honolulu. In addition to his other duties on this field trip, Dr. Lessa will also study the responses of the Islanders to the typhoon for the Academy-Research Council Disaster Research Group, which is partially supporting his trip.

SYMPOSIUM ON MUTATION AND PLANT BREEDING

More than 180 foreign and domestic geneticists and plant breeders met at Cornell University, November 28-December 2, for a Symposium on Mutation and Plant Breeding.

Twenty-six scientists in the field of plant breeding and statistical genetics participated in the program. The symposium was divided into five sections which included: The Nature and Characteristics of Mutations, Mutagenic Agents and Interpretation of their Effects, Evaluation of Mutations in Plant Breeding, Utilization of Induced Mutations, and Possibilities for the Future.

Because of the vast amount of material that needed to be covered it was necessary to divide the program into two divisions. The second portion of the program will be covered in a Symposium on Plant Breeding and Statistical Genetics scheduled for March 20-24, at North Carolina State College, Raleigh, N. C.

Preparations for these symposia actually began in 1956, shortly after the committee was appointed by the Agricultural Board. When formulating and studying the need for a Committee on Plant Breeding and Genetics, members of the Board felt it desirable to have an evaluation made of the present status of the use of induced muta-

tions in plant breeding and to review the current and active experiments in mutation breeding and the related field of basic genetics. The Committee on Plant Breeding and Genetics agreed that the most efficient way to fulfill this pledge was by holding symposia.

Support for the symposia was received from the National Science Foundation, National Institutes of Health, Atomic Energy Commission, and the U. S. Agricultural Research Service. Published proceedings of both symposia will be made available.

Members of the Committee on Plant Breeding and Genetics are:

R. P. MURPHY, Department of Plant Breeding, College of Agriculture, Cornell University, *Chairman*
R. A. BRINK, Department of Genetics, University of Wisconsin
F. L. PATTERSON, Department of Agronomy, Purdue University
H. F. ROBINSON, Department of Experimental Statistics, North Carolina State College
W. R. SINGLETON, Department of Biology, University of Virginia
G. F. SPRAGUE, Research Agronomist, Cereal Crops Research Branch, U. S. Department of Agriculture

ADVISORY COMMITTEE ON SOVIET EXCHANGES

Detlev W. Bronk, President of the National Academy of Sciences, and H. P. Robertson, Foreign Secretary, have invited 14 scientists to serve on an Advisory Committee on Scientific Exchanges with the Soviet Union. Paul Doty, Harvard University, has accepted appointment as chairman. The first meeting of the committee will be held at the Academy on February 11.

A principal purpose of the Committee will be to review past scientific exchanges with the U.S.S.R. in order to recommend future conduct of such exchanges for the benefit of the American scientific community. The Committee will be asked to provide recommendations for any future exchange program with the Soviet Academy of Sciences after the expiration of the current Bronk-Nesmeyanov agreement of July 9, 1959. Its assistance will also be sought in connection with the selection of American scientists to go to the U.S.S.R. under the inter-Academy program.

NEUROSPORA INFORMATION CONFERENCE

The first Neurospora Information Conference, sponsored by the Division of Biology and Agriculture and supported by the National Science Foundation and the Atomic Energy Commission, will be held, March 2-4, at the University of California at La Jolla.

About 75 investigators engaged in genetic and biochemical genetic research with the slime mold, *Neurospora*, will be invited to participate. The goal of this Conference is to promote communication and the exchange of ideas in order to facilitate and encourage productive research by the investigators using this organism.

Formal papers will neither be given during the Conference nor published afterward, but a general résumé of the proceedings will be prepared and sent to all *Neurospora* workers in this country and to others scattered throughout the world.

The chairmen and proposed areas of research to be covered are as follows:

Cytology and Ultrastructure:

STERLING EMERSON, California Institute of Technology

Nuclear Cytology and Cytogenetics:

PATRICIA ST. LAWRENCE, University of California at Berkeley

Methodology and Communication:

RAYMOND BARRATT, Dartmouth College

Reciprocal Recombination:

DAVID PERKINS, Stanford University

Nonreciprocal Recombination:

FREDERICK DE SERRES, Oak Ridge National Laboratory

Allelic Complementation—Mechanism and Topology:

NORMAN GILES, Yale University

Genetic Fine Structure in Relation to Enzyme Structure and Activity:

SIGMUND SUSKIND, Johns Hopkins University

Reversion in Relation to Enzyme Structure and Activity:

DOW WOODWARD, Brooks Air Force Base

Genetic Interaction in Enzyme Synthesis:

NORMAN HOROWITZ, California Institute of Technology

MAN LIVING IN THE ARCTIC

A conference on "Man Living in the Arctic," sponsored jointly by the Advisory Board on Quartermaster Research and Development, the Arctic Institute of North America, and the Quartermaster Research and Engineering Command, was held in Natick, Mass., December 1 and 2. Paul A. Siple of the Army Research Office was chairman of the planning committee and general chairman of the conference.

Some 350 governmental, military, industrial, and academic scientists and representatives assembled for the two-day conference to review the past and present contributions to man living in the Arctic, to examine new scientific approaches to solving man's problems in living there, and to discuss the possibilities of expanding the use of the Arctic wastes in the future.

A highlight of the program was a dinner at Boston's Museum of Science at which the American Pioneers of Arctic Exploration were honored. The three living pioneers Col. Bernt Balchen, U.S.A.F. (Ret.), Rear Adm. Donald B. MacMillan, U.S.N. (Ret.), and Vilhjalmur Stefansson attended. An illustrated commentary was given by Lowell Thomas. Another major part of the program was the dedication of the Arctic climatic chamber at the Command in honor of the late Sir Hubert Wilkins, world-famed explorer of the Arctic and Antarctic and consultant to the quartermaster Corps for 16 years.

The proceedings of the conference will be published.

NEW SERIES OF EXPOSITIONAL PROGRAMS

On December 19, 1960, as a guest of the Prevention of Deterioration Center, William P. Lloyd, Director, Test and Evaluation Laboratory, Army Guided Missile Agency (ARGMA), presented "Missile System Test Capabilities of the Army Rocket and Guided Missile Agency, Redstone Arsenal," to a group of approximately 100 environmental, test, and reliability scientists in the Washington-Baltimore area.

Mr. Lloyd's exposition covered the full capabilities of rocket and missile testing at

Redstone both in laboratory and field test trials. Two short descriptive motion picture films, a model of an optical guidance device, and numerous still slides on the schematics of dynamic and static testing, instrumentation, and data handling, served well in bringing Redstone facilities to Washington. After the presentation an informal discussion and question period followed in which Mr. Lloyd was joined by George C. Travers, Jr., Deputy Chief, Test Management Office, ARGMA.

Two additional non-ARGMA films on environments were also presented on the program. These were the U. S. Army Ordnance Corps, Yuma Test Activity production entitled "The Desert Story," and the U. S. Army Engineering Corps film "Greenland."

This new endeavor by the Prevention of Deterioration Center is an attempt to achieve cognizance, establish rapport, and improve liaison between groups having similar needs and interests. This initial program was well received as reflected by a questionnaire survey conducted at the close of the meeting. Results of the survey indicate a desire for a continuing program of visitation by "proxy," and several laboratories and test stations were suggested as subjects for succeeding meetings.

MARITIME CARGO TRANSPORTATION CONFERENCE

The annual meeting of the Board of the Maritime Cargo Transportation Conference (MCTC) was held at the Academy on November 15.

An important presentation by the staff involved a proposed new project entitled "Shipboard Mechanization and Manpower." This project involves the development and analysis of facts surrounding the introduction of new technologies in ship operation. It was pointed out that emotional barriers arise rapidly to hinder technological innovations, particularly where there is fear of resulting unemployment. However, where factual, objective studies present reliable estimates to all parties of the potential costs and gains derived from the orderly

insertion of system improvements, then emotional barriers diminish.

MCTC's plans involve the collection and analysis of information and the evaluation of the impact of potential changes in terms of cost for management, and in terms of work opportunity and the need for new skills for labor. Careful consideration will be given to the potential rate of introduction of these improvements, to the phasing of this rate with labor force attrition and training, and to the economic attractiveness of such technological changes to American ship owners.

Vice Admiral Ralph E. Wilson, USN (Ret.), Chairman of the Federal Maritime Board and Maritime Administrator, and a member of the MCTC Board, stated at the meeting that this project was timely and that he would support it. The Board approved the proposal as appropriate for performance by MCTC.

CONFERENCE ON ELECTRICAL INSULATION

The 29th Annual Meeting of the Conference on Electrical Insulation was held October 17-19, 1960, at the National Bureau of Standards, Washington, D. C., with an attendance of 206 members and visitors.

Twenty-seven technical papers were presented at the five technical sessions. Informal roundtable discussions were also held on preselected broad topics related to electrical insulation.

Arthur R. von Hippel of the Massachusetts Institute of Technology presented the sixth Whitehead Memorial Lecture. The subject of his lecture was "In Search of Understanding."

The guest speaker at the Conference banquet was R. D. Huntoon of the National Bureau of Standards who spoke on the development of the proximity fuze.

The following officers were nominated for the 1961 Conference:

S. I. REYNOLDS, General Electric Research Laboratory, Schenectady, N. Y., *Chairman*

PHILIP J. FRANKLIN, Diamond Ordnance Fuze Laboratory, *Vice Chairman*

JOSEPH STITCHER, Detroit Edison Company, *Secretary*

The place and time selected for the 1961 Annual Meeting was Pocono Manor, Pa., October 23-25. It was voted to hold the 1962 meeting at the Hershey Hotel, Hershey, Pa., October 15-17.

The Proceedings of the 29th Annual Meeting will be published in February 1961.

FULBRIGHT AWARDS 1962-63

The Conference Board of Associated Research Councils, Committee on International Exchange of Persons, will issue in March 1961, announcements of 1962-63 awards under the Fulbright Act for university lecturing and advanced research in the following countries of the Pacific, South and Southeast Asia, and Latin America: Australia and New Zealand; Burma, Ceylon, India, Korea, Pakistan, Philippines, and Thailand; Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay.

Application forms and detailed program information may be obtained by writing to the Committee at the Academy-Research Council. Applications should be submitted between March 1 and April 25, 1961.

VISITING INTERNATIONAL SCIENTIST PROGRAM

The American Geological Institute is sponsoring lecture tours of six geological scientists during the second half of the 1960-61 academic year under its Visiting International Scientist Program aided by a grant from the National Science Foundation.

The visiting geologists are:

ROLAND BRINKMAN, University of Bonn, Germany
AUGUSTO GANSSE, University of Zurich, Switzerland

JEAN GOGUEL, Director, Service de la Carte Géologique, Paris, France

HISASHI KUNO, University of Tokyo, Japan
HENDRIK SCHUILING, Union Minière du Haut-Katanga, Brussels, Belgium

R. W. VAN BEMMEL, University of Utrecht, Netherlands

The program will provide for lecture visits by the foreign scientists to almost fifty graduate departments of geology-geophys-

ics in the United States and Canada. The visitors also will come in contact with many professional scientific groups through laboratory visits, field excursions and attendance at scientific meetings.

AGI INTERNATIONAL FIELD INSTITUTE

An International Field Institute for United States college geology teachers will be held in Great Britain during the summer of 1961, sponsored by the American Geological Institute under a grant from the National Science Foundation.

The purpose of the 8-week summer program is to permit a selected group of twenty college and university teachers of geology to become familiar in the field with the classic geologic areas of Wales, Northern Ireland, Scotland, and the South Coast of England under the leadership of recognized British geological scientists.

Directors of the Institute Program will be Frank H. T. Rhodes, University College of Swansea, Wales, and Paul R. Shaffer, University of Illinois. British scientists assisting as field leaders are:

J. G. C. ANDERSON, University of Cardiff
T. R. OWEN, University College of Swansea
W. S. PITCHER, King's College, University of London
R. M. SHACKLETON, University of Liverpool
P. C. SYLVESTER-BRADLEY, University of Leicester
ALWYN WILLIAMS, Queen's University, Belfast

Institute participants will receive travel and subsistence allowances. Applications must be filed before February 15, 1961. An AGI Selection Committee will screen applications and the participants selected will be announced on or before March 1. Application inquiries should be addressed to Paul R. Shaffer, AGI International Field Institute-1961, % Department of Geology, University of Illinois, Urbana, Ill.

FOREIGN FIELD RESEARCH PROGRAM

On December 12, 1960, a screening committee consisting of Edward A. Ackerman, Carnegie Institution of Washington; Robert Platt, University of Chicago; Richard Russell, Louisiana State University; and Ed-

ward B. Espenshade, Jr., Chairman of Division of Earth Sciences, *ex officio*, met at the Academy building to consider applications for the sixth competition under the Foreign Field Research Program. Thirty-one applications were reviewed, representing 20 schools and 10 regions of interest.

The 8 applications selected bring to 53 the number of projects supported under the program. Nine reports have been published, two will be published shortly, and three are being edited for publication.

This program, which is supported by the Geography Branch of the Office of Naval Research and administered by the Division of Earth Sciences, provides opportunities for young American scientists to undertake studies abroad on subjects of their own choosing.

The Committee recommended the following eight proposals for support and all recipients of awards have accepted:

WILLIAM M. DENEVAN (University of California at Berkeley)
The Llanos de Mojos, Northeastern Bolivia: a Seasonally Inundated Tropical Lowland
DAVID DICHTER (London University)
The Regional Geography of Pakistan's Northwest Frontier
CHRIS FIELD (University of California at Los Angeles)
Distribution and Classification of Agricultural Terraces in the South Central Andes
HOWARD L. GAUTHIER, Jr. (Northwestern University)
The Regional Pattern of Transportation and Urban Development in Sao Paulo, Brazil
A. DAVID HILL (University of Chicago) Road Development and Land-Use Change in Villa Las Rosas, Chiapas
EUGENE WILHELM Jr. (Louisiana State University)
The General Forest Ecology of the Lake Country of South Chile and Argentina
CHARLES W. WOOLEVER (Syracuse University)
The Effects of Political Partition on the Manufacturing Development of the Old Indian Province of Bengal
JULIAN WOLPERT (University of Wisconsin)
Areal Variations in Farm Income in Middle Sweden

STAFF APPOINTMENTS

The Institute of Laboratory Animal Resources has announced the appointment of **Ronald T. Hopwood** as a professional associate. Dr. Hopwood received his doctor of veterinary medicine degree from the University of Pennsylvania in 1958 and served

two years with the U. S. Army at the Biological Warfare Laboratories, Fort Detrick, Md. He was engaged in private practice before joining the staff of the Institute.

The Office of Documentation has announced the appointment of **Lilly L. Kay** as assistant to the director. Mrs. Kay matriculated at the University of Berlin and holds a "Certificat d'Etudes françaises" from the University of Lausanne (Switzerland), granted in 1934. Before coming to the Academy-Research Council, she was employed by the Auerbach Electronics Corp. of Philadelphia. Besides being a freelance writer, Mrs. Kay formerly did research and writing for *Time* magazine and served as a staff member of the American Geographical Society and the Twentieth Century Fund.

The Division of Medical Sciences reports the resignations of **Margaret A. Sloan** and **James R. Weisiger** on February 1. Dr.

Sloan will join the staff of the National Cancer Institute and Dr. Weisiger will seek new horizons in the service of the pharmaceutical industry.

At the turn of the year the Division was strengthened by the addition of a Professional Associate, **Otto E. Van Der Aue**. Dr. Aue, recently retired from the U. S. Navy after a distinguished career in military medicine. He received his M. D. degree from the University of Illinois in 1931, after which he entered the naval service. He has long been interested in problems of environmental medicine and has been in close touch with the national effort in medical research while serving 5 years as commanding officer of the Naval Medical Research Institute. This was preceded by a four and one-half year's tour as Director of the Submarine Medicine Division of the Bureau of Medicine and Surgery and as liaison officer to the Bureau of Ships.

RECORD OF MEETINGS

November

1 Nuclear Science Committee
Ad hoc Panel on the Role of Patents in Research, *New York City*
Committee on Ship Structural Design, Project SR-153 Advisory Committee, *Boston*

2 Ad hoc Committee on Training of Analytical Chemists
Federal Construction Council, Task Group on Piling

3 Ad hoc Committee on Research Problems of Mutual Interest and Concern to Users and Producers of Asphaltic Materials, *Dallas*
Committee on Dietary Allowances
Food and Nutrition Board, Executive Committee
U. S. National Committee, International Union of Nutritional Sciences

4 Nuclear Data Group
Highway Research Board, Subcommittee of Executive Committee
Food and Nutrition Board

4-5 Council of American Institute of Nutrition

November

9 Advisory Screening Committee for Fulbright Awards in Chemistry and Chemical Technology
Armed Forces-National Research Council Committee on Vision, Executive Council
Federal Construction Council, Operating Committee
Advisory Screening Committee for Fulbright Fellowships in Engineering and Industrial Research
Ad hoc Committee on De-Icing Damage to Bridge Structures
Advisory Screening Committee for Fulbright Fellowships in Medical Sciences
Office of Documentation, Advisory Committee
National Science Foundation Senior Postdoctoral Fellowship Evaluation Committees
National Science Foundation Senior Postdoctoral Fellowship Evaluation Board
Advisory Committee on Survey of Apparatus for Science Teaching

November		December	
14	Committee on Astronomy Advisory to Office of Naval Research AASHO Road Test, Special Studies Panel	2	Subcommittee on Food Sanitation Ad hoc Committee on Preparation and Purification of Substances of Certified High Purity
15	Armed Forces-National Research Council Committee on Hearing and Bio-Acoustics, Executive Council	3	Committee on Photobiology
15-16	Maritime Cargo Transportation Con- ference	4	Committee on Oceanography, In- dian Ocean Panel
15-17	Armed Forces-National Research Council Committee on Hearing and Bio-Acoustics	5	Committee on Toxicology
16	Building Research Institute Fall Conferences	5-6	Plastics Study Group
16	Working Group 3 on Bio-Acoustic Problems of Astronautics	6	Materials Advisory Board, Refrac- tory Metals Sheet Rolling Panel
16	Committee on Textile Functional Finishing, <i>Natick, Mass.</i>	7	Subcommittee on Toxicology
17	Committee on Urban Research AASHO Road Test, Statistical Panel, <i>Ottawa, Ill.</i>	7-8	Building Research Advisory Board
17	Federal Construction Council, Task Group on Thermal Insulation for Piping	7-9	Space Science Board, Joint Meeting of Committees 7 and 13
17-18	Nuclear Data Project	7-10	Planning Committee for De- salination Research Study
17-18	Working Group 6 on Visual Dis- plays	8	Food Protection Committee and Industrial Liaison Panel, Joint Meeting
18	Committee on Food Stability, <i>Chi- cago</i>	8-9	Committee on International Ex- change
18	Federal Construction Council, Task Group on Piling	8-10	Exchange of Persons, Advisory Committees
21	Committee on Sarcoidosis	9	Conference on Airborne Infection, <i>Miami Beach</i>
21	U. S. National Committee, Interna- tional Union of Biological Sciences	9-10	Symposium on Science and Food: Today and Tomorrow
21	Subcommittee on Oncology	9-10	Committee on Kinetics of Chemical Reactions, <i>Canton, N. Y.</i>
21	U. S. National Committee, Interna- tional Union on Physiological Sciences	9-10	Committee on Prosthetics Research and Development, <i>Los Angeles</i>
22	Advisory Screening Committee for Fulbright Fellowships in Physical Sciences	10	Federal Construction Council, Task Group on Expansion and Con- traction Joints in Concrete Masonry Construction
23	Ad hoc Committee on Material Deterioration	11	Committee on Geography, Advisory to Office of Naval Research, <i>Gaithersburg, Md.</i>
23	Subcommittee on Plasma, <i>Cam- bridge, Mass.</i>	11	U. S. National Committee, Interna- tional Union of Biochemistry
27	Committee on Blood and Related Problems, <i>Montreal, Canada</i>	12	Division of Earth Sciences, Execu- tive Committee
28	Advisory Committee on Disaster Research, Executive Council		National Academy of Sciences— National Research Council, Gov- erning Board
28-29	Committee on Naval Medical Re- search, <i>San Francisco</i>	12-14	Screening Committee for Foreign Field Research Program
December			Highway Research Board, Subcom- mittee of Executive Committee, <i>Chicago</i>
1	Nuclear Data Project	13-14	U. S. National Committee, Interna- tional Scientific Radio Union, <i>Boulder, Colo.</i>
1-2	Federal Construction Council, Task Group on Piling	14	Symposium on Designs for Use of Brittle Materials
2	Conference on Man Living in the Arctic, <i>Natick, Mass.</i>		Ad hoc Committee on Snake Bite Therapy
2	Committee on Prosthetics Educa- tion and Information, <i>Chicago</i>		Ad hoc Committee on the Purpose and Scope of the Committees of the Department of Traffic and Operations
	Subcommittee on Pesticide-Wildlife Loss Problems		Subcommittee on Thrombosis and Hemorrhage
	Committee on Tissue Transplanta- tion		

December		December	
14-17	Conference on Recent Progress and Present Problems in the Field of Shock	19	U. S. National Committee, International Union Against Cancer
15	Nuclear Data Project		Committee on Geography, Advisory to Department of State
15-16	Committee on Oceanography, Panel on New Devices		Committee on Deterioration
16	Committee on Sarcoidosis	20	Division of Engineering and Industrial Research, Executive Committee, <i>New York City</i>
	Committee on a National Atlas of the United States		Committee on International Exchange of Persons
17	Committee on Shock and Committee on Trauma, Joint Meeting		U. S. National Committee, International Institute of Refrigeration
17-18	Ad hoc Committee on the Eleanor Roosevelt Foundation Cancer Fellowships of the International Union Against Cancer		Federal Construction Council, Operating Committee
	Committee on Oceanography		Ad hoc Panel on Engineering Research in Developing Countries
	Committee on Modular Dimensioning		

NEW PUBLICATIONS

de Kazinczy, F., and Backofen, W. A. *Influence of Hot-Rolling Conditions on Brittle Fracture in Steel Plate*. Washington, NAS-NRC, 1960. (Ship Structure Committee. Serial No. SSC-126) 26 p., illus.

Fairhall, A. W. *The Radiochemistry of Beryllium*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-13]) 58 p. \$0.75. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)

Federal Construction Council. Task Group T-40 on Evaluation of Components for Underground Heat Distribution Systems. *Evaluation of Components for Underground Heat Distribution Systems*. Washington, 1960. (NAS-NRC Publication 828. Report No. 39 for the Federal Construction Council.) 18 p. \$1.50.

Federal Construction Council. Task Group T-42 on Criteria for the Acceptance of Cast Iron Soil Pipe. *Criteria for the Acceptance of Cast Iron Soil Pipe*. Washington, 1960. (NAS-NRC Publication 836. Report No. 40 for the Federal Construction Council.) 46 p., illus. \$2.00.

Finch, Glen, ed. *Educational and Training Media, a Symposium . . . August 18-19, 1959*. Washington, 1960. (NAS-NRC Publication 789.) 206 p., illus. \$2.00.

Gartlein, Carl W., and Sprague, Gale C., comps. *Report on IGY Visual Auroral Observations*. Washington, NAS-NRC, 1960. (National Academy of Sciences, IGY World Data Center A. IGY General Report No. 12.) 103 p. \$1.00.

Index-Handbook of Cardiovascular Agents, Volume 2 (1951-1955). Isaac D. Welt, Director, Cardiovascular Literature Project, Division of Medical Sciences. Washington, 1960. (NAS-NRC Publication 821.) 1568 p. (in 2 parts). \$15.00 for the two parts (not sold separately).

Industrial Research Laboratories of the United States, Eleventh Edition. Compiled by John H. Gribbin and Sue Singer Krogfus. Washington, 1960. (NAS-NRC Publication 844.) 698 p. \$12.00.

Krafft, J. M., and Sullivan, A. M. *Influence of Speed of Deformation on Strength Properties in the Post Lower Yield Stress-Strain-Curve of Mild Steel*. Washington, NAS-NRC, 1960. (Ship Structure Committee. Serial No. SSC-127) 23 pp.

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National Research Council. Building Research Institute. *Proposals for New Building Research*. Washington, 1960. (NAS-NRC Publication 831.) 72 p. \$4.00.

National Research Council. Committee on Biological Chemistry. *Specifications and Criteria for Biochemical Compounds*. Washington, 1960. (NAS-NRC Publication 719.) [132] p., looseleaf, binder not available from NAS-NRC. Domestic: \$1.00 cash, \$1.50 by invoice. Overseas: \$1.50 cash, \$2.00 by invoice.

National Research Council. Committee on Oceanography. *Oceanography 1960 to 1970. 9—Ocean-Wide Surveys*. Washington, NAS-NRC, 1960. 22 p.

National Research Council. Division of Earth Sciences. *Annual Report, 1959-1960*. Washington, NAS-NRC, 1960. 66 p.

National Research Council. Food Protection Committee. *The Safety of Mono- and Diglycerides for Use as Intentional Additives in Foods. Reprinted with Appendix Added, March 1960.* Washington, 1960. (NAS-NRC Publication 251.) 16 p.

National Research Council. Highway Research Board. *Automatic Equipment for Freezing-and-Thawing Tests.* Washington, 1960. (NAS-NRC Publication 768. Highway Research Board Bulletin 259.) 27 p. \$0.80.

National Research Council. Highway Research Board. *Bases and Foundations on Frozen Soil.* Washington, 1960. (NAS-NRC Publication 804. Highway Research Board Special Report 58.) 93 p. \$3.00.

National Research Council. Highway Research Board. *Driving Simulators and Application of Electronics to Highways.* Washington, 1960. (NAS-NRC Publication 770. Highway Research Board Bulletin 261.) 60 p. \$1.40.

National Research Council. Highway Research Board. *Electronic Surveying, 1960 Developments.* Washington, 1960. (NAS-NRC Publication 767. Highway Research Board Bulletin 258.) 31 p. \$0.80.

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National Research Council. Highway Research Board. *Highway Contracts, a Legal Analysis.* Washington, 1960. (NAS-NRC Publication 803. Highway Research Board Special Report 57.) 144 p. \$4.00.

National Research Council. Highway Research Board. *Night Visibility: 1960.* Washington, 1960. (NAS-NRC Publication 764. Highway Research Board Bulletin 255.) 195 p. \$4.00.

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National Research Council. Highway Research Board. *Repair of Structures and Pavement by Thin Concrete Patching.* Washington, 1960. (NAS-NRC Publication 769. Highway Research Board Bulletin 260.) 24 p. \$0.60.

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National Research Council. Space Science Board. *Science in Space. Galactic and Extragalactic Astronomy; Chapter VIII of a Report in Progress . . .* Washington, NAS-NRC, 1960. 49 p. \$1.00.

Pearman, J. P. T., and Guttmacher, Ilene, comps. *A Second Compilation of U.S. IGY Rocket Program Results.* Washington, NAS-NRC, 1960. (National Academy of Sciences, IGY World Data Center A, Rockets and Satellites. IGY Rocket Report No. 6.) 198 p., illus. \$1.00.

Notice of Academy Meetings

NATIONAL ACADEMY OF SCIENCES

Annual Meeting, Washington, D. C., April 24-26, 1961

NATIONAL RESEARCH COUNCIL

Annual Meeting, Washington, D. C., March 9-11, 1961

NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL

Governing Board, Washington, D. C., April 23, 1961

Governing Board, Washington, D. C., June 11, 1961

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*The search for Truth is in one way hard
and in another easy. For it is evident that no one
can master it fully nor miss it wholly. But each adds
a little to our knowledge of Nature, and from all
the facts assembled there arises a certain grandeur.*

—ARISTOTLE

